

MIL-E-1/1047B  
30 September 1985

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**SUPERSEDING**

MIL-E-1/1047A  
26 August 1970

**MILITARY SPECIFICATION SHEET**

ELECTRON TUBE, NEGATIVE GRID (MICROWAVE)  
TYPE 2C41

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The complete requirements for acquiring the electron tube described herein shall consist of this document and the latest issue of MIL-E-1.

DESCRIPTION: Triode, planar, glass and metal

See figure 1

**Mounting position:** Any

**Weight:** 2.25 ounces nominal

ABSOLUTE RATINGS: Anode pulsed oscillator

Parameter:	F1	Ef	Ec	epy	fb	fc	fk	tp	Du	Pp	Pg	Rg	tk	TE
Unit:	MHz	V	Vdc	kV	a	a.	a	μs	---	W	W	Ohms	sec	°C
	(See note 1)													
Maximum:	3,000	6.6	-150	3.5	4	2.5	6.5	3	0.0025	35	2	---	---	175
	(See note 2)													(See note 3)
Minimum:	---	5.7	---	---	---	---	---	---	---	---	---	20	60	---

**TEST CONDITIONS:**

<b>Parameter:</b>	Ef	Eb	Rk	Ck	tk
<b>Unit:</b>	V	Vdc	Ohms	uF	sec
	6.3	600	30	1,000	300

**GENERAL:**

**Qualification - Required.**

2C41

Method	Requirement or test	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
<u>Quality conformance inspection, part 1</u>							
1266	Total grid current	3, 5		I <sub>c</sub>	---	-8.0	μAdc
1256	Electrode current (1) (anode)	3		I <sub>b</sub>	60	95	mAdc
1306	Transconductance			S <sub>m</sub>	20,000	30,000	μmhos
1211	Insulation of electrodes		E <sub>b</sub> = E <sub>k</sub> = 0; E <sub>c</sub> = -500 Vdc	R	50	---	Meg
1231	Pulsing emission		p <sub>rr</sub> = 600 (max); t <sub>p</sub> = 3 μs (max); e <sub>b</sub> = e <sub>c</sub> = e <sub>d</sub> /i <sub>s</sub> = 6a	e <sub>td</sub>	---	225	V
1236	Power oscillation (1) (pulse)	6, 7	F = 3,000 MHz (min); e <sub>py</sub> = 3.5 kv; R <sub>g</sub> /I <sub>b</sub> = 4a or I <sub>b</sub> = 10 mAdc with I <sub>c</sub> = 6 mAdc (max); E <sub>c</sub> = -1.5 V (min); E <sub>f</sub> = 5.8 V	P <sub>o(1)</sub>	7	---	W (useful)
1301	Heater current			I <sub>f</sub>	0.95	1.10	A
<u>Quality conformance inspection, part 2</u>							
---	Resonance	6, 8	No voltages applied	---	---	---	---
---	Grid arcing	9	e <sub>b</sub> = 0; e <sub>gx</sub> = 400 v (60 Hz); R <sub>g</sub> /I <sub>c</sub> = 100 mAdc	---	---	---	---
1236	Power oscillation (2) (pulse)	6, 7	F = 3,000 MHz (min); e <sub>py</sub> = 3.5 kv; R <sub>g</sub> /I <sub>b</sub> = 3a or I <sub>b</sub> = 7.5 mAdc with I <sub>c</sub> = 4.5 mAdc (max); E <sub>c</sub> = -1.5 V (min); E <sub>f</sub> = 5.9 V	P <sub>o(2)</sub>	4	---	W (useful)
1261	Electrode voltage (grid)	3	E <sub>c</sub> /I <sub>b</sub> = 1.0 mAdc	E <sub>c</sub>	---	-15	Vdc
---	Bandwidth, rf	10	Power oscillation (1) (pulse)	Band-width	---	1.0	MHz
1331	Direct-interelectrode capacitance	6	Use fixture per Drawing 158-JAN	C <sub>gk</sub> C <sub>gp</sub> C <sub>pk</sub>	5.60 1.86 ---	7.60 2.16 0.035	pF pF pF

Method	Requirement or test	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
<u>Quality conformance inspection, part 3</u>							
---	Life (1)		Group C; power oscillation(1)(pulse); t = 100 hours	---	---	---	---
---	Life (1) - test end point						
1236	Power oscillation (1) (pulse)	6, 7	F = 3,000 MHz (min); I <sub>epy</sub> = 3.5 kv; R <sub>g</sub> /I <sub>b</sub> = 4a or I <sub>b</sub> = 10 mAdc with I <sub>c</sub> = 6 mAdc (max); E <sub>c</sub> = -1.5 V (min); E <sub>f</sub> = 5.8 V	ΔPo(1)	---	30	%
---	Life (2)		Group D; power oscillation(2)(pulse); E <sub>f</sub> = 6.1 V ±1%; t = 200 hours	---	---	---	---
---	Life (2) - test end point						
1236	Power oscillation (2) (pulse)	6, 7	F = 3,000 MHz (min); I <sub>epy</sub> = 3.5 kv; R <sub>g</sub> /I <sub>b</sub> = 3a or I <sub>b</sub> = 7.5 mAdc with I <sub>c</sub> = 4.5 mAdc (max); E <sub>c</sub> = -1.5 V (min); E <sub>f</sub> = 5.7 V ±1%	ΔPo(2)	---	30	%
1031	Low-frequency vibration	6, 11	E <sub>c</sub> /I <sub>b</sub> = 10 mAdc; R <sub>p</sub> = 10,000 ohms; E <sub>bb</sub> = 300 Vdc	E <sub>p</sub>	---	100	mVac
---	Torque	6,11,12	No voltages applied	---	---	---	---
---	Torque-test end point						
1266	Total grid current	3		I <sub>c</sub>	---	-10	μAdc
1042	Shock, specified pulse	6,11,13	Condition A	---	---	---	---
---	Shock, specified pulse-test end point						
1266	Total grid current	3		I <sub>c</sub>	---	-10	μAdc

## NOTES:

1. The transit-time heating effect of the cathode shall be compensated for by a reduction in heater voltage after dynamic operation of the tube has started. The back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for a particular set of operating conditions. A maximum variation of ±5 percent from optimum is permitted. No reduction in heater voltage is required up to and including 500 MHz.
2. The regulation or series-anode-supply impedance, or both, shall limit the instantaneous peak current, with the tube considered as a short circuit, to a maximum of 10 times the specified maximum current rating.

## NOTES: - Continued

3. Sufficient conduction and convection cooling shall be provided to limit the radiator and envelope temperature to the specified maximum at 175°C under all operating conditions. Reliability will be seriously impaired if this maximum temperature is exceeded.
4. The AQL (percent defective) for each test listed under QCI, part 1, shall be 0.65, inspection level II.
5. This test shall be the first test performed at the conclusion of the holding period.
6. Other tube contact configurations may be used provided the tube contact area remains unchanged and the socket, jig, or cavity gives equal performance. Mounting of the jig, socket, or cavity may be at the option of the manufacturer.
7. The applied voltage pulse shape shall be measured with noninductive resistor of 1,150 ohms  $\pm$ 2 percent inserted in place of the tube. The pulse shape shall be  $t_p = 3.0 \mu s \pm 10$  percent,  $t_r = 0.4 \mu s$  maximum,  $t_f = 0.7 \mu s$  maximum. The pulse repetition rate shall be adjusted so that  $D_u = 0.0025 \pm 5$  percent with the above measured pulse length. Test in cavity in accordance with Drawing 279-JAN. The cavity shall be connected to a load with a VSWR less than 1.5. The oscillator output coupling and grid or cathode resistor may be adjusted for maximum power output.
8. Grid-anode resonance: Test in cavity in accordance with Drawing 278-JAN. Cavity shall resonate at 1,354  $\pm 2.0$  MHz with tuning slug in accordance with Drawing 277-JAN at TA = 25°C  $\pm 5^\circ$ C.

Grid-cathode resonance: Test in cavity in accordance with Drawing 283-JAN. Cavity shall resonate at 1,719  $\pm 2.0$  MHz with tuning slug in accordance with Drawing 277-JAN at TA = 25°C  $\pm 5^\circ$ C.

When plotted on graphs of resonant frequency versus grid-anode capacitance and resonant frequency versus grid-cathode capacitance, the tube under test shall be represented by a point within a parallelogram whose four corners are located by the following points:

Points	Capacitance (pF)		Frequency (MHz)	
	C-gp	C-gk	F-gp	F-gk
1	1.86	5.60	1927.5	1745
2	1.86	5.60	1997.5	1815
3	2.16	7.60	1842.5	1700
4	2.16	7.60	1912.5	1770

9. There shall be no evidence of grid to cathode arcing or grid current instability when tested in a circuit per Drawing 255-JAN. This test shall be performed before the pulsing emission and power oscillation (pulse) tests. Initial arcing is permitted if followed by a 15-second period with no indications of subsequent arcing.
10. The rf bandwidth measured at one-quarter power by means of an rf spectrometer shall be within the limits specified.
11. This test shall be performed during the initial production and once each succeeding 12-calendar month period in which there is production. A regular double sampling plan shall be used, with the first sample of three tubes having an acceptance number of zero, and a second sample of three tubes having a combined acceptance number of one. In the event of failure, the test shall be made as a part of quality conformance inspection, part 2, inspection level S3, with an AQL of 6.5. The regular "12 calendar month" double sampling plan shall be reinstated after three consecutive samples have been accepted.

NOTES: - Continued

12. Torque test shall be performed as follows:

(a) The tube shall be held securely at the cathode connection. A force of 5 pounds shall be applied to the heater cup without perceptible shock. This test may be made by applying the force at right angles to the inside of the cup at a point  $7/64$  (2.78 mm)  $\pm 1/64$  inch (0.40 mm) from the cathode end of the tube. An approved equivalent method may be used. The heater cup shall not loosen or short circuit on the cathode connection. This part of the test shall not be required if the space between the heater cup and the cathode sleeve is completely filled with insulating material.

(b) A torque of 15 inch-pounds shall be applied between anode and cathode without shock.

13. Test in jig in accordance with Drawing 159-JAN.

14. Revision letters are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Ltr	Dimensions in inches with metric equivalents (mm) in parentheses	Minimum	Maximum
<b>Quality conformance inspection, part 2</b>			
A	1.815 (46.10)	1.875 (47.63)	
B	---	1.534 (38.96)	
C	---	1.475 (37.47)	
D	1.289 (32.74)	1.329 (33.76)	
F	---	.980 (24.89)	
G	.462 (11.73)	.477 (12.12)	
J	.766 (19.46)	.826 (20.98)	
N	1.025 (26.04)	1.035 (26.29)	
R	.655 (16.64)	.665 (16.89)	
T	.213 (5.41)	.223 (5.66)	
U	.315 (8.00)	.325 (8.26)	
<b>Quality conformance inspection, part 3 (see note P)</b>			
H	---	.040 (1.02)	
I	.125 (3.18)	.185 (4.70)	
K	.025 (0.64)	.046 (1.17)	
L	1.234 (31.34)	1.264 (32.11)	
M	1.180 (29.97)	1.195 (30.35)	
P	---	.812 (20.62)	
S	---	.545 (13.84)	
V	---	.086 (2.18)	
W	---	.100 (2.54)	
X	---	.035 (0.89)	
Y	.105 (2.67)	.145 (3.68)	
Z	.650 (16.51)	.850 (21.59)	
<b>Electrode contact areas (see note q)</b>			
AA	.035 (0.89)	.361 (9.17)	
AB	1.185 (30.10)	1.265 (32.13)	
AC	1.534 (38.96)	1.728 (43.89)	
AD	1.475 (37.47)	1.815 (46.10)	

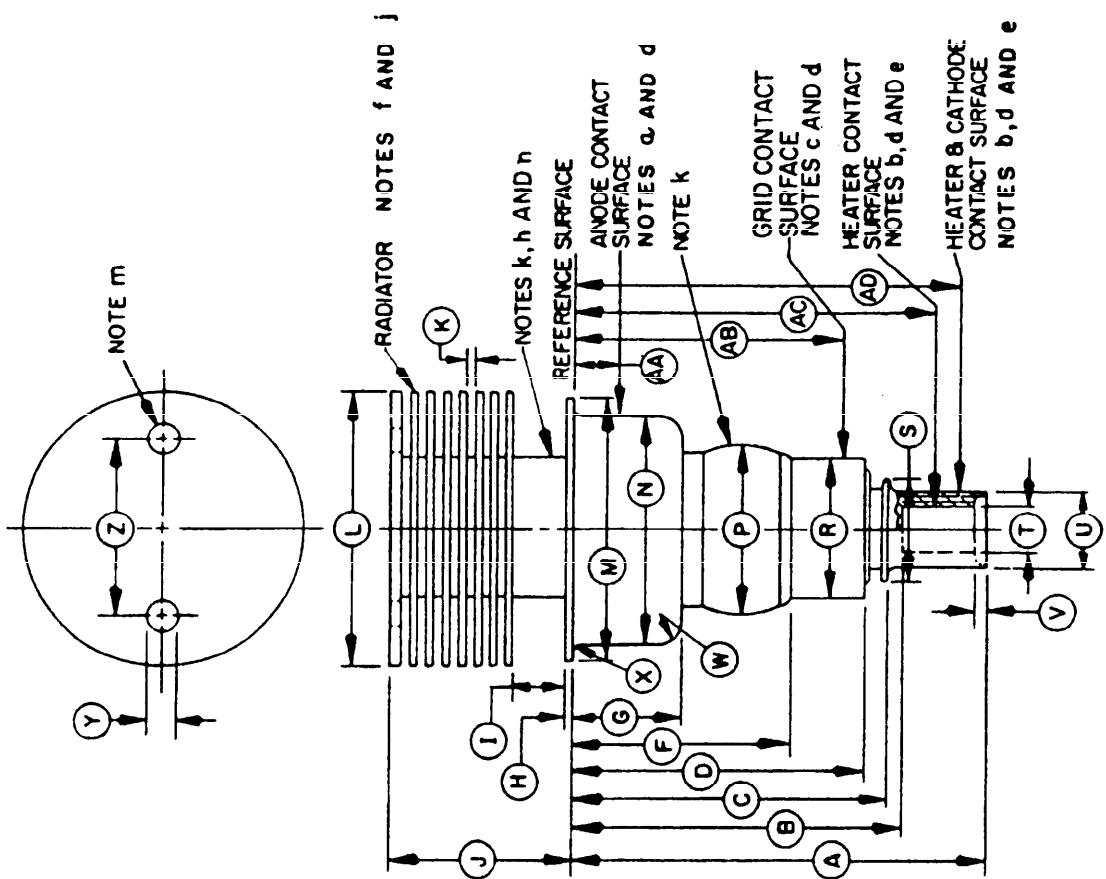


FIGURE 1. Outline drawing of electron tube type 2C41.

## NOTES:

- a. The total indicated runout of the anode contact surface with respect to the cathode contact surface shall not exceed .020 (0.51 mm).
- b. The total indicated runout of the cathode contact surface with respect to the heater contact surface shall not exceed .012 (0.30 mm).
- c. The total indicated runout of the grid contact surface with respect to the cathode contact surface shall not exceed .020 (0.51 mm).
- d. Measure total indicated runout at the centerline dimension for the applicable contact area. Diameters N, R, T and U shall apply throughout the entire contact area as defined by dimensions AA, AB, AC and AD, respectively.
- e. Inner edge of heater and outer edge of cathode rf connection shall be free from burrs and sharp edges.
- f. Distortion of fins permissible provided distance between adjacent fins at any point around the circumference meets dimension K.
- g. Silver plate 30 MSI on all external metal surfaces.
- h. Radiator and radiator support need not be plated when made of copper, aluminum or equivalent, approved by the bureau or agency concerned.
- j. Fin at outer end of tube shall have sufficient strength to withstand a drop test from a 6-inch (152.40 mm) height without distortion as judged by ability to maintain dimension K and not loosening. Test 10 tubes per month. If more than one tube fails, test reverts to an AQL of 6.5 inspection level of S3 for all lots in process.
- k. Do not clamp or locate on this surface.
- m. Hole provided for tube extractor through top fin only.
- n. Measure anode shank temperature on this surface.
- p. These dimensions, and the dimensions in notes a, b, c, and g, shall be checked during the initial production and once each succeeding 12-calendar month period in which there is production. A regular double sampling plan shall be used, with the first sample of three tubes having an acceptance number of zero, and a second sample of three tubes having a combined acceptance number of one. In the event of failure, the dimensions shall be checked as a part of quality conformance inspection, part 2, inspection level S3, with an AQL of 6.5. The regular 12-calendar month double sampling plan shall be reinstated after three consecutive samples have been accepted.
- q. Dimensions in electrode contact areas table are for socket design purposes and are not intended for inspection purposes.

FIGURE 1. Outline drawing of electron tube type 2041 - Continued.

**Custodians:**  
Army - ER  
Navy - EC  
Air Force - 85

**Preparing activity:**  
Army - ER  
(Project 5960-3361-1)

**Review activities:**  
Air Force - 11, 99  
DLA - ES

**User activities:**  
Navy - AS, CG, MC, OS  
Air Force - 19

**Agent:**  
DLA - ES